into the (ΔX,ΔY) packet produced by the next sample with only a tiny hesitation in the perceived cursor motion.

The increased sensitivity of the touch sensor system of the present invention allows for a lighter input finger touch which makes it easy for human use. Increased sensitivity also makes it easier to use other input objects, like pen styli, etc. Additionally, this sensitivity allows for a tradeoff against a thicker protective layer, or different materials, which both can allow for lower manufacturing costs.

Greater noise rejection allows for greater flexibility in use and reduced sensitivity to spurious noise problems. Two techniques are employed which allow derivation of the most noise-rejection benefit.

Due to the drive and sense techniques employed in the present invention, the data acquisition rate has been increased by about a factor of 30 over the prior art. This offers several obvious side effects. First, for the same level of signal processing, the circuitry can be turned off most of the time and reduce power consumption by roughly a factor of 30 in the analog section of the design. Second, since more data is available, more signal processing, such as filtering and gesture recognition, can be performed.

The sensor electronic circuit employed in the present invention is very robust and calibrates out process and systematic errors. It will process the capacitive information from the sensor and provide digital information to an external device, for example, a microprocessor.

Because of the unique physical features of the present invention, there are several ergonomically interesting applications that were not previously possible. Presently a mouse or trackball is not physically convenient to use on portable computers. The present invention provides a very convenient and easy-to-use cursor position solution that replaces those devices.

In mouse-type applications, the sensor of the present invention may be placed in a convenient location, e.g., below the "space bar" key in a portable computer. When placed in this location, the thumb of the user may be used as the position pointer on the sensor to control the cursor position on the computer screen. The cursor may then be moved without the need for the user's fingers to leave the keyboard. Ergonomically, this is similar to the concept of the Macintosh Power Book with its trackball, however the present invention provides a significant advantage in size over the trackball. Extensions of this basic idea are possible in that two sensors could be placed below the "space bar" key for even more feature control.

The computer display with its cursor feedback is one small example of a very general area of application where a display could be a field of lights or LEDs, an LCD display, or a CRT. Examples include touch controls on laboratory equipment where present equipment uses a knob/button/touch screen combination. Because of the articulating ability of this interface, one or more of those inputs could be combined into one of the inputs described with respect to the present invention.

Consumer Electronic Equipment (stereos, graphic equalizers, mixers) applications often utilize significant front panel surface area for slide potentiometers because variable control is needed. The present invention can provide such control in one small touch pad location. As Electronic Home Systems become more common, denser and more powerful human interface is needed. The sensor technology of the present invention permits a very dense control panel. Hand-held TV/VCR/Stereo controls could be ergonomically formed and allow for more powerful features if this sensor technology is used.

The sensor of the present invention can be conformed to any surface and can be made to detect multiple touching points, making possible a more powerful joystick. The unique pressure detection ability of the sensor technology of the present invention is also key to this application. Computer games, "remote" controls (hobby electronics, planes), and machine tool controls are a few examples of applications which would benefit from the sensor technology of the present invention.

Musical keyboards (synthesizers, electric pianos) require velocity sensitive keys which can be provided by the pressure sensing ability of this sensor. There are also pitch bending controls, and other slide switches that could be replaced with this technology. An even more unique application comprises a musical instrument that creates notes as a function of the position and pressure of the hands and fingers in a very articulate 3-d interface.

The sensor technology of the present invention can best detect any conducting material pressing against it. By adding a compressible insulating layer covered by a layer of conductive material on top of the sensor the sensor of the present invention may also indirectly detect pressure from any object being handled, regardless of its electrical conductivity.

Because of the amount of information available from this sensor it will serve very well as an input device to virtual reality machines. It is easy to envision a construction that allows position-monitoring in three dimensions and some degree of response (pressure) to actions.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

What is claimed is:

1. A method for recognizing an extended drag gesture made on a touch-sensor pad in a touch-sensing system providing X and Y position information to a host, including the steps of:

detecting a first presence of a conductive object on the touch-sensor pad of a first duration between a start and a finish of said first presence;

comparing said first duration with a first reference amount of time;

initiating a gesture signal to the host indicating the occurrence of a gesture if said first duration is less than said first reference amount of time;

detecting a second presence of a conductive object on the touch-sensor pad of a second duration between a start and a finish of said second presence;

comparing a first elapsed time between said finish of said first presence and said start of said second presence with a second reference amount of time;

maintaining said gesture signal and repeatedly sending X and Y position information to said host for said second duration if said first elapsed time is less than said second reference amount of time;

detecting a third presence of a conductive object on the touch-sensor pad of a third duration between a start and a finish of said third presence;

comparing a second elapsed time between said finish of said second presence and said start of said third presence with a third reference amount of time; and

maintaining said gesture signal and repeatedly sending X and Y position information to said host for said second